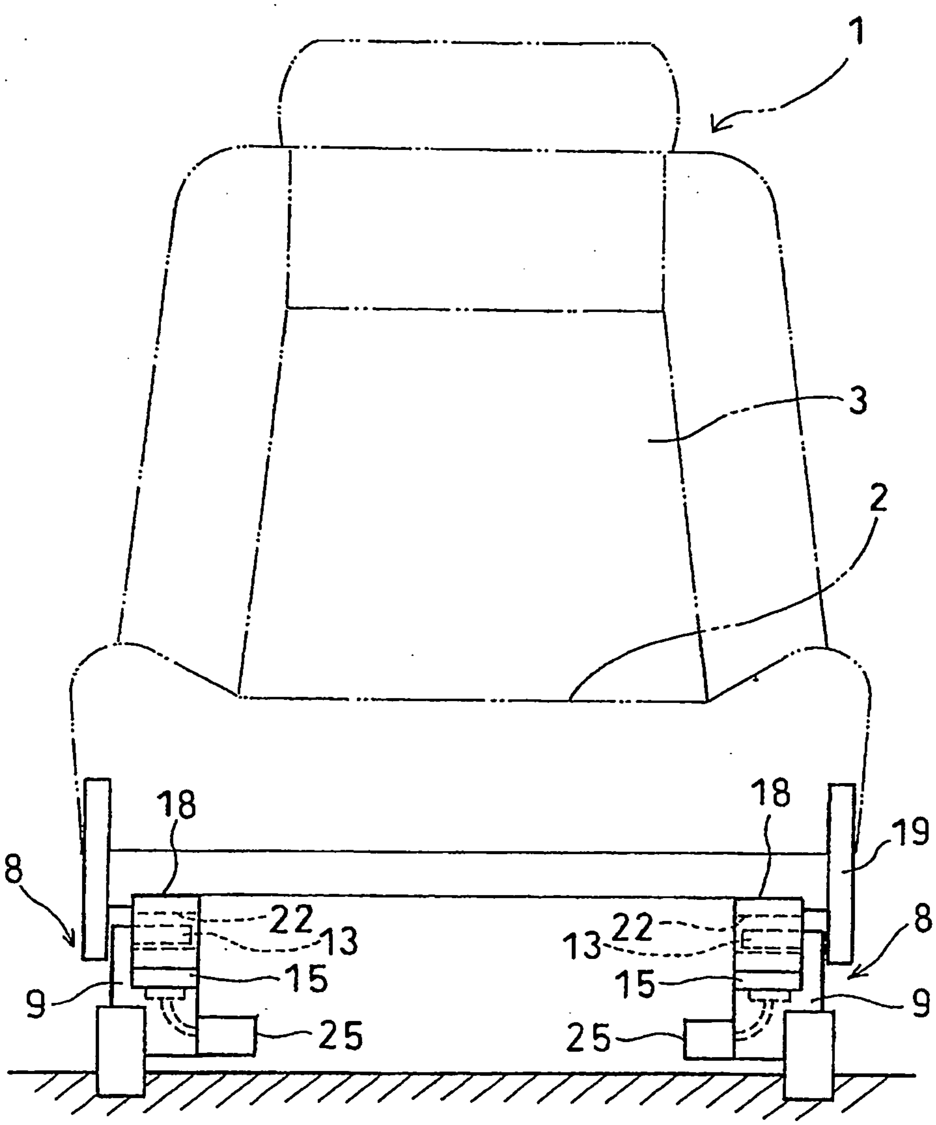

Fig. 1

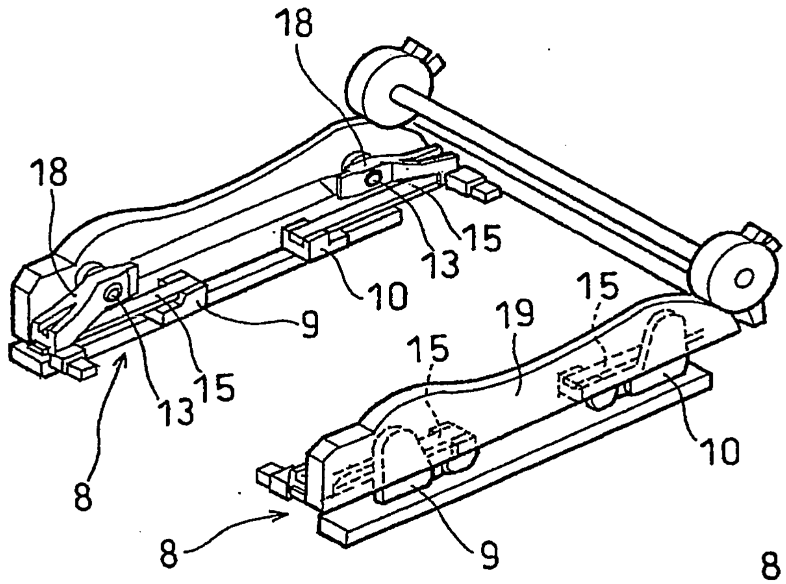
18
18
15
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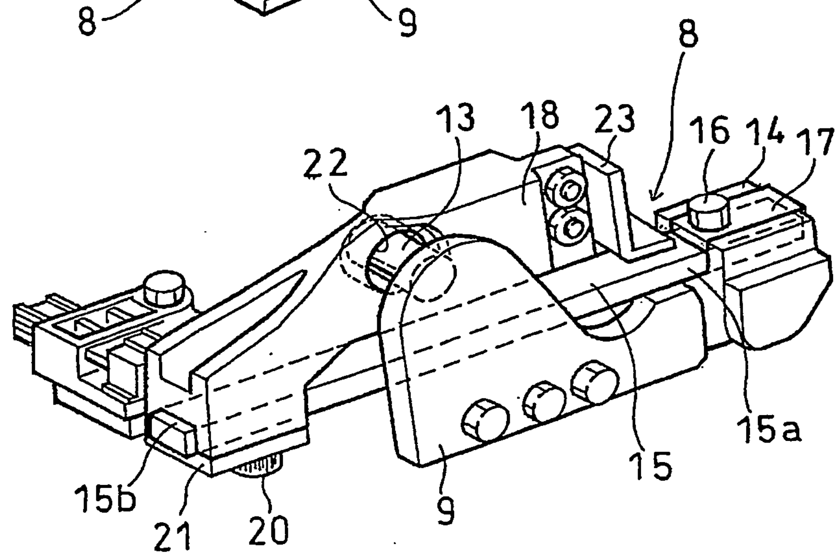
Fig. 2(a)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15a
15
15b
21
20
9

Fig. 2(b)

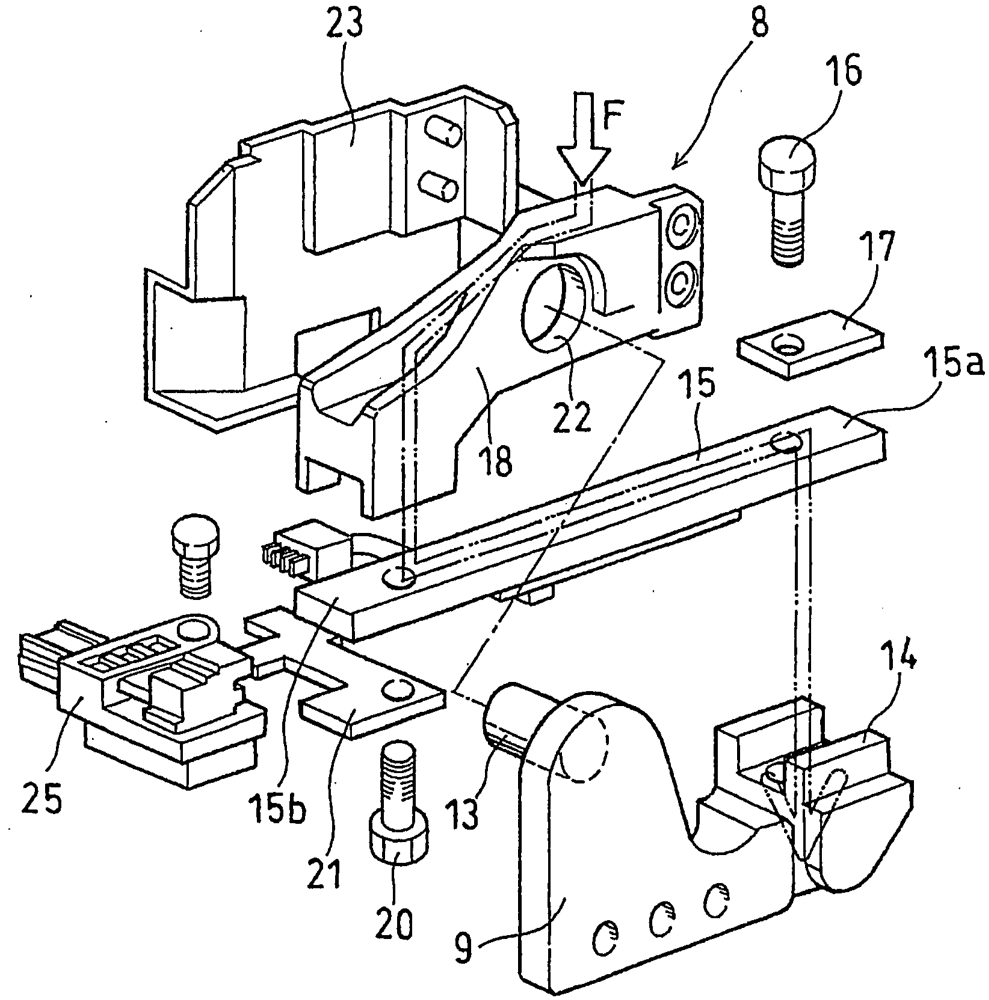


Fig. 3

Fig.4(a)

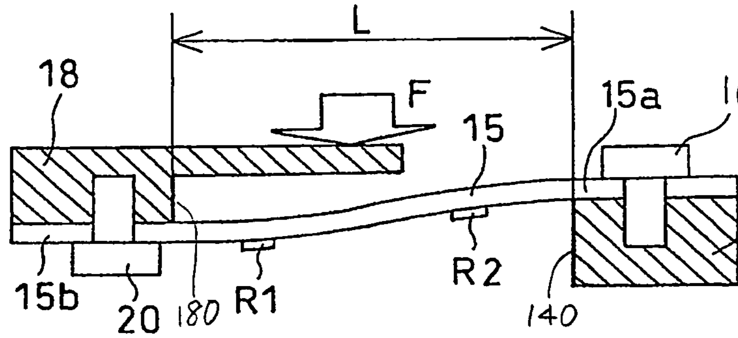


Fig.4(b)

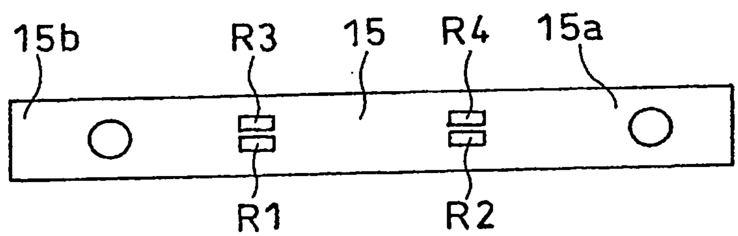
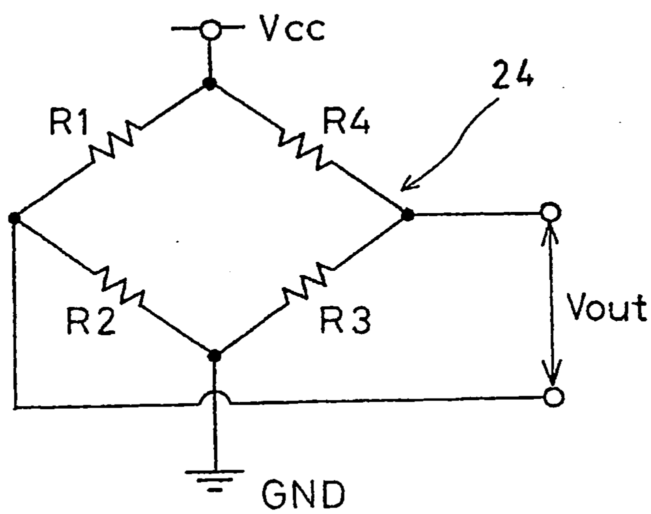
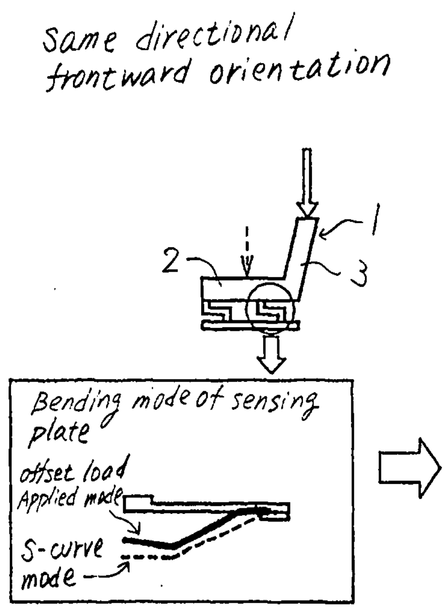


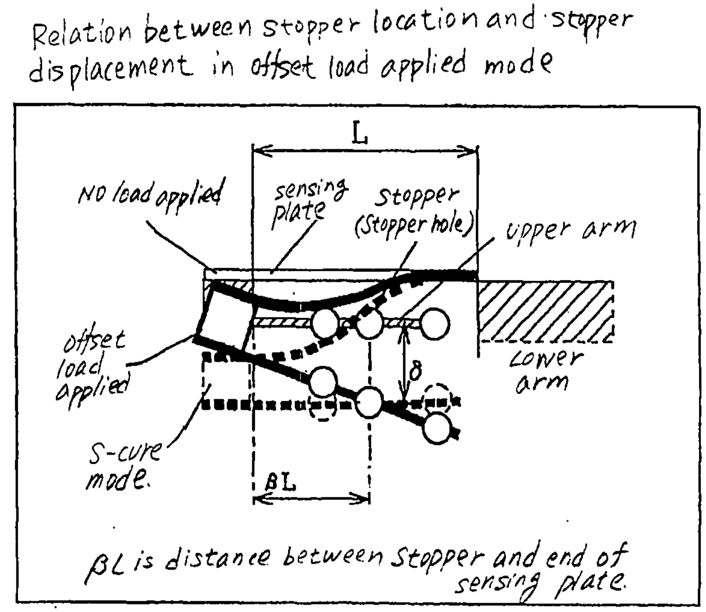
Fig.4(c)





Same directional
frontward orientation
1
2
3
Bending mode of sensing plate
offset load Applied mode
S-curve mode

Fig. 5(a)



Relation between stopper location and stopper displacement in offset load applied mode
L
No load applied
sensing plate
Stopper (Stopper hole)
upper arm
Lower arm
offset load applied
δ
S-cure mode.
βL
βL is distance between Stopper and end of sensing plate.

Fig. 5(b)

TABLE I

Bending Mode and Dynamic model upon Application of Offset Load

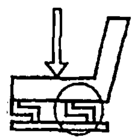
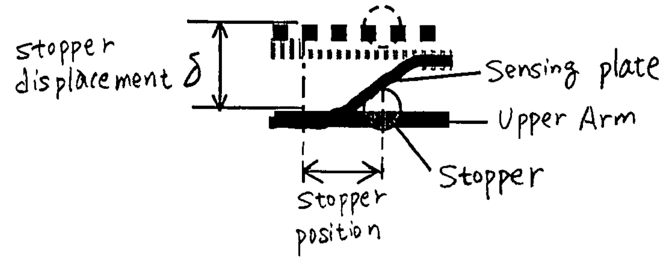
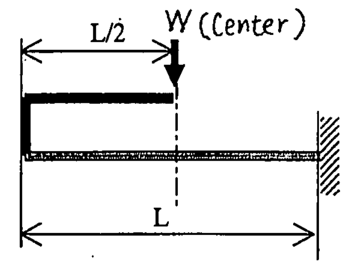
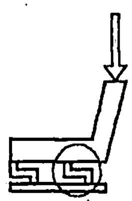
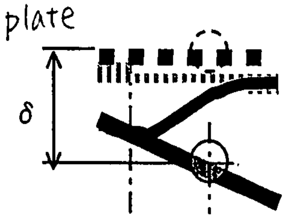
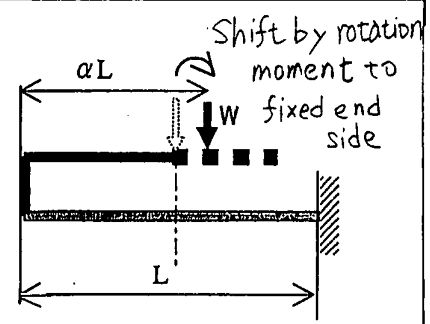
	Applied Mode of Load	Bending Mode	Dynamic Model causing bending as illustrated left
Ideal S-curve Bending	Cushion-Loaded Mode 		
Offset Load Bending	Seat back-Loaded Mode 	Input of Great rotation moment to sensing plate 	

Fig. 6

TABLE II

Sensor installed orientation and Bending mode upon application of offset load

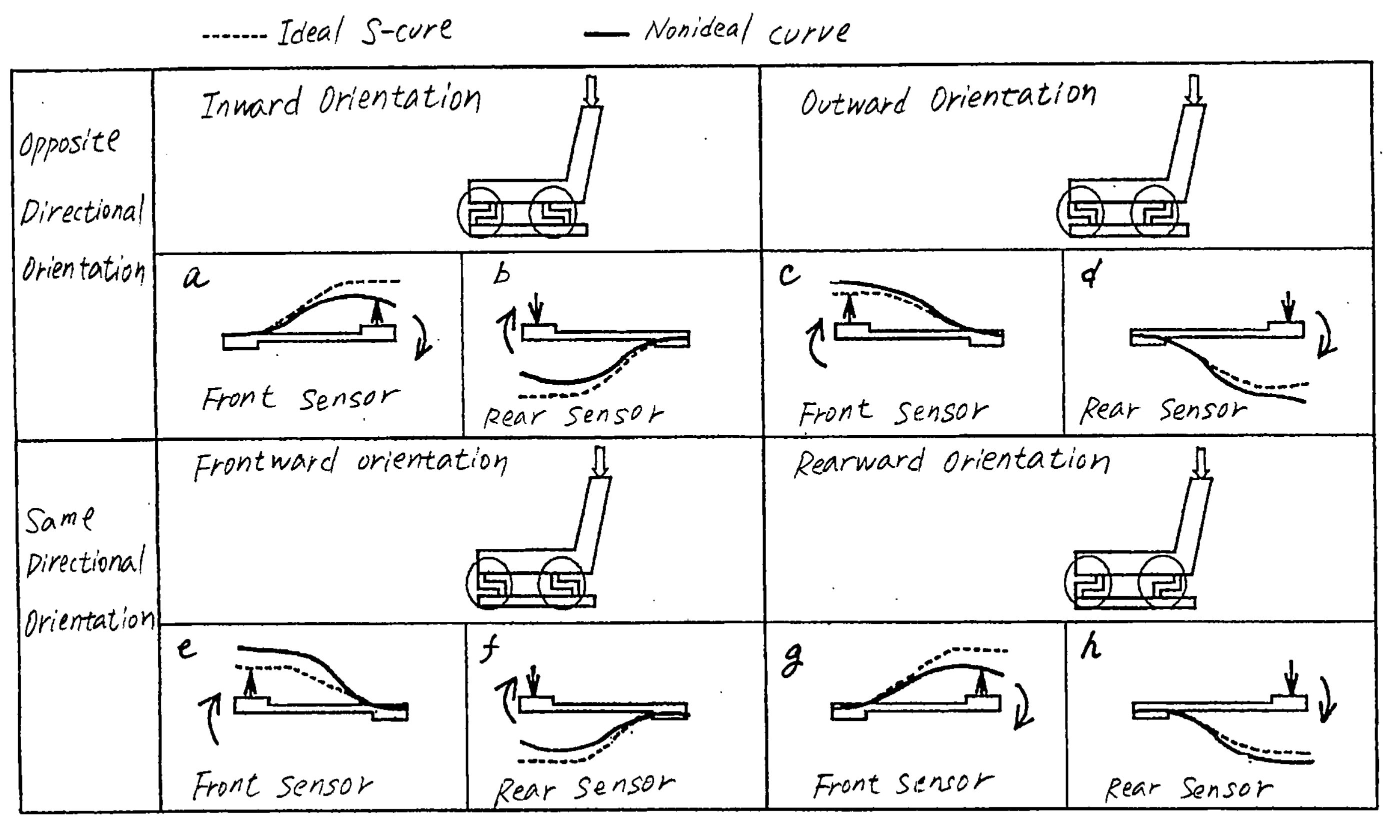
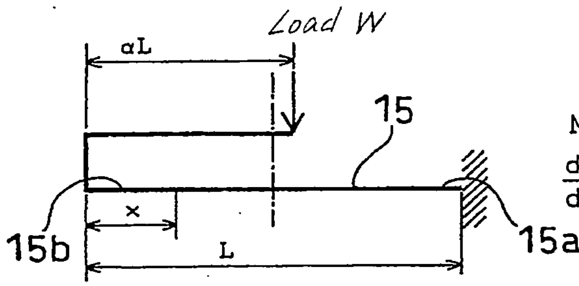


Fig.7

Stopper Displacement Equation



$$M(x) = Wx - \alpha L W \quad \cdots (1)$$

$$\frac{d^2y}{dx^2} = \frac{-M}{EI} = \frac{W}{EI}(\alpha L - x)$$

Angle of Inclination of sensing plate

$$Ik(x) = \frac{dy}{dx}$$
$$= \frac{W}{2EI}\{-x^2 + 2\alpha L \cdot x + (1-2\alpha)L^2\} \quad \cdots (2)$$

Displacement of sensing plate (Expressed by positive value in downward direction)

$$Yk(x) = \int Ik(x)\,dx$$
$$= \frac{(-W)}{6EI}\{-x^3 + 3\alpha L \cdot x^2 + (3-6\alpha)L^2 \cdot x + (3\alpha-2)L^3\} \quad \cdots (3)$$

Fig.8

Stopper Displacement Equation.

Fig. 9(a)

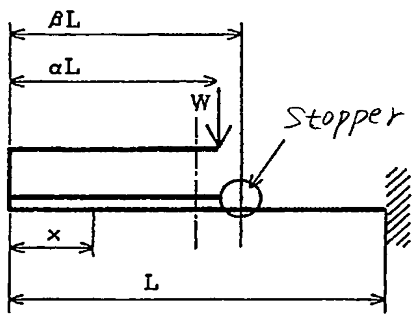
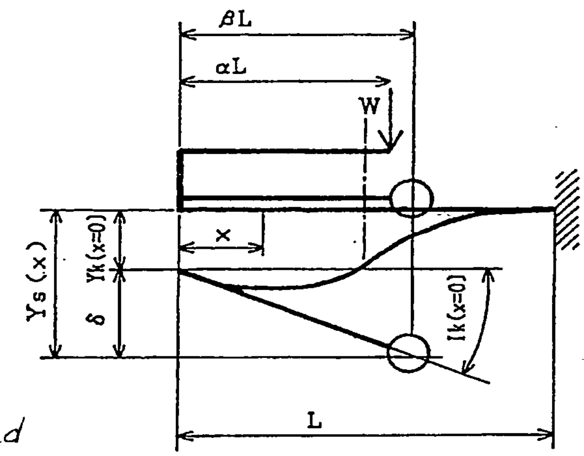


Fig. 9(b)



αL : Applied location of load
βL : Stopper position.
Y_s : Stopper displacement

$$
\begin{aligned}
Ys &= Yk(x=0) + \delta \\
&= Yk(x=0) + \beta \cdot L \cdot \tan\{Ik(x=0)\} \\
&= \frac{WL^3}{6EI}\{(2-3\alpha)-3\beta(1-2\alpha)\} \quad \cdots (4)
\end{aligned}
$$

$$\sigma max = \frac{Mmax}{Z} = -\frac{\alpha LW}{Z} \quad \cdots (5)$$

$$Ys = \frac{L^2}{3\alpha Et}\{(2-3\alpha)-3\beta(1-2\alpha)\} \cdot \sigma max \quad \cdots (6)$$

$$Ys = \frac{2L^3}{Ebt^3}\{(2-3\alpha)-3\beta(1-2\alpha)\} \cdot W \quad \cdots (7)$$

TABLE III

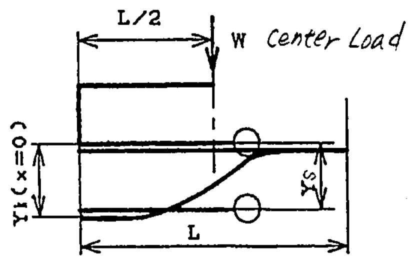
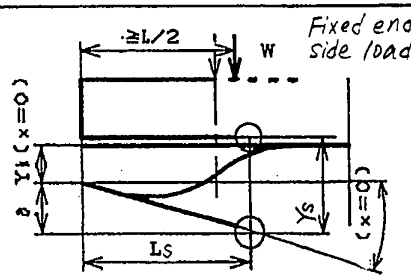
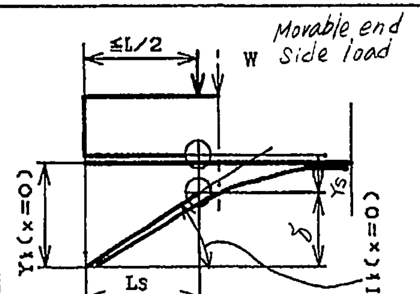
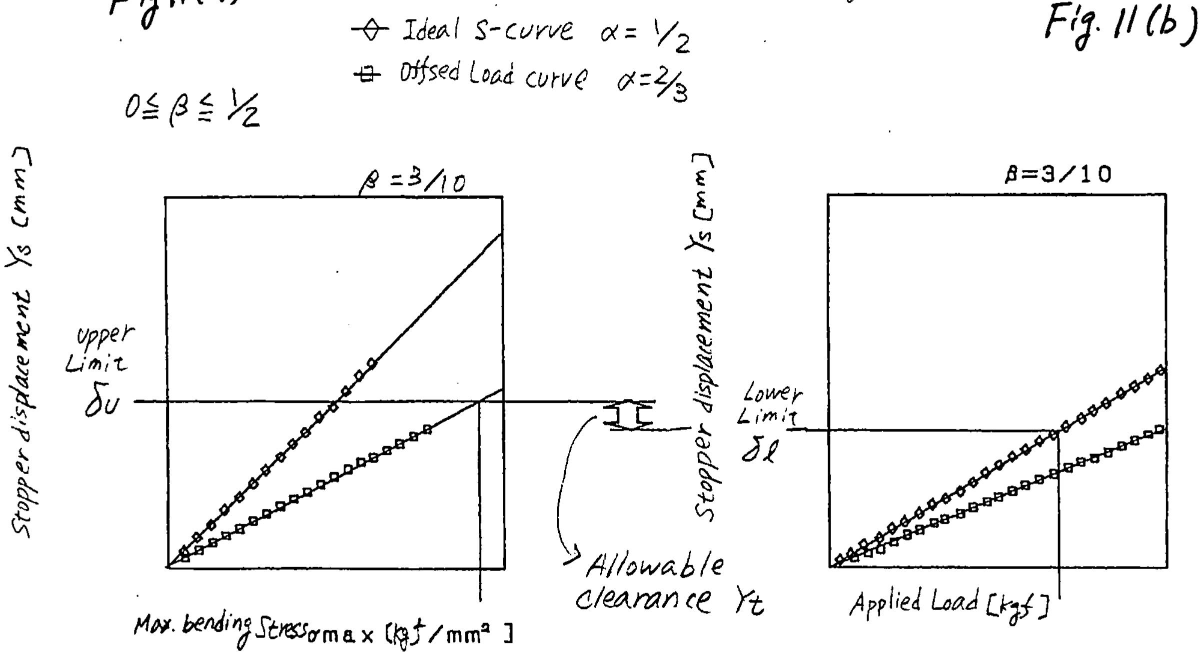
<table>
<tr><th colspan="3">Bending Mode</th><th>Stopper displacement -to-position relation</th></tr>
<tr><td colspan="2">Ideal S-curve Bending Mode</td><td>
</td><td>Ys : Stopper displacement
Yk : Movable end displacement
$Ys = Yk\ (x=0)$
Stopper displacement is independent of stopper position</td></tr>
<tr><td rowspan="2">Offset Load Apply Mode</td><td>Fixed end Offsed load Apply Mode</td><td>
</td><td>δ : Stopper displacement resulting from inclination of movable end
$Ys = Yk(x=0) + \delta$
$= Yk(x=0) + Ls \cdot \tan[Ik(x=0)]$
Stopper displacement depends on Stopper position</td></tr>
<tr><td>Movable end offsed load Apply Mode</td><td>
</td><td>$Ys = Yk(x=0) - \delta$
$= Yk(x=0) - Ls \cdot \tan[Ik(x=0)]$
Stopper displacement depends on stopper position</td></tr>
</table>

Fig. 10

Stopper allowable clearance equation

Fig 11(a)   Fig. 11(b)



$$\delta u = \frac{L^2}{2Et}\beta \cdot \sigma e \cdots (6.1)$$

$$\delta l = \frac{L^3 \cdot W1}{Ebt^3} \cdots (7.1)$$

$$\delta u - \delta l = Yt = \frac{L^2}{2Et} \cdot \sigma e \cdot \beta - \frac{L^3 \cdot W1}{Ebt^3} \cdots (8)$$

δe = Stress Limit

W1 = Lowest Load in Load Measurement range

Stopper Allowable Clearance Equation.

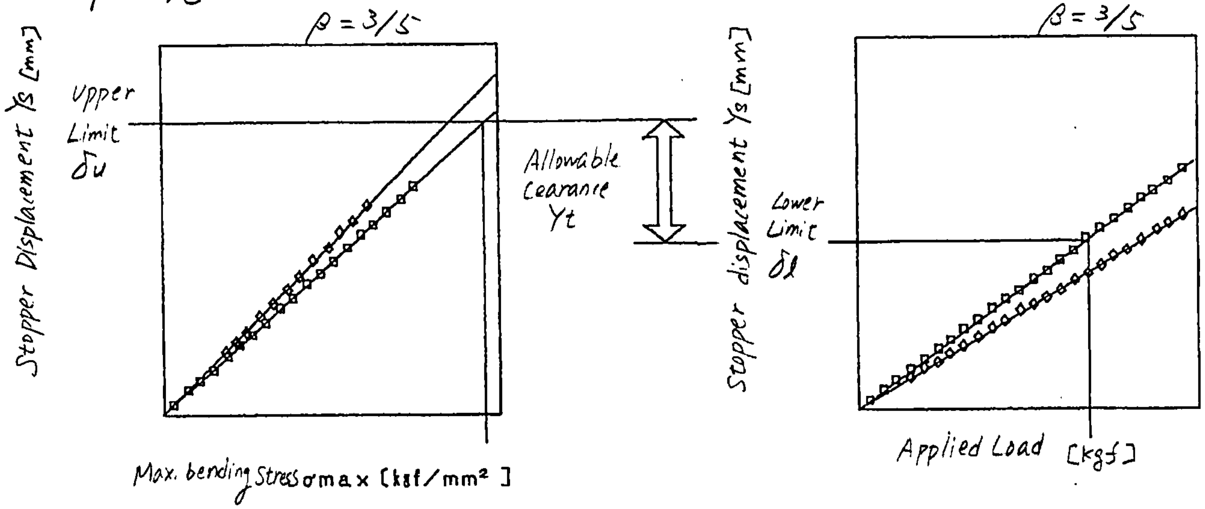
◇ Ideal S-curve $\alpha = 1/2$

□ offset Load curve $\alpha = 2/3$

Fig.12(a)

Fig12(b)

$1/2 \leqq \beta \leqq 2/3$



$$\delta u = \frac{L^2}{2Et} \beta \cdot \sigma e \cdots \quad (6.2)$$

$$\delta l = \frac{2L^3 \cdot \beta \cdot Wl}{Ebt^3} \cdots \quad (7.2)$$

$$\delta u - \delta l = Yt = \frac{L^2}{2Et} \cdot \beta \cdot \sigma e - \frac{2L^3 \cdot \beta \cdot Wl}{Ebt^3} \cdots \quad (9)$$

δe = Stress Limit

Wl = Lowest Load in Load Measurement range

Stopper Allowable Clearance Equation

$\beta \geqq 2/3$

- ◇ Ideal S-curve $\alpha = 1/2$
- ◻ offsed Load curve $\alpha = 2/3$

Fig. 13(a)

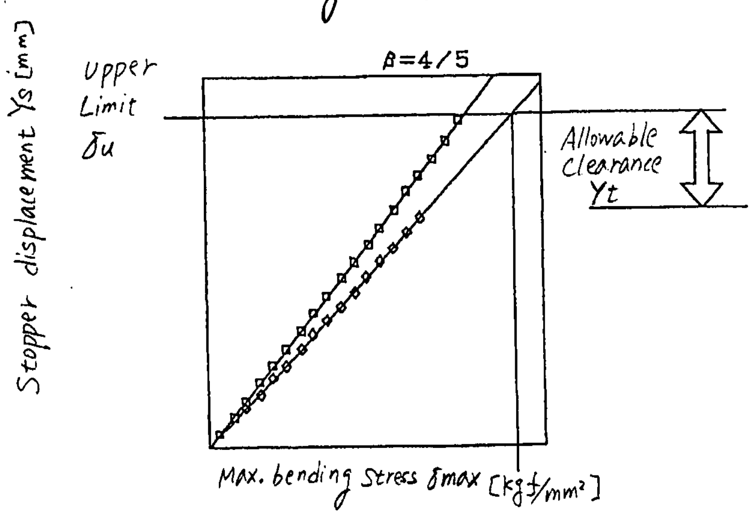
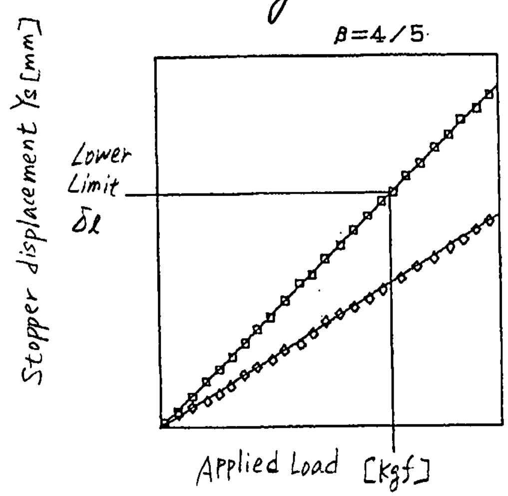


Fig. 13(b)



$$\delta u = \frac{L^2}{3Et}\sigma e \cdots (6.3)$$

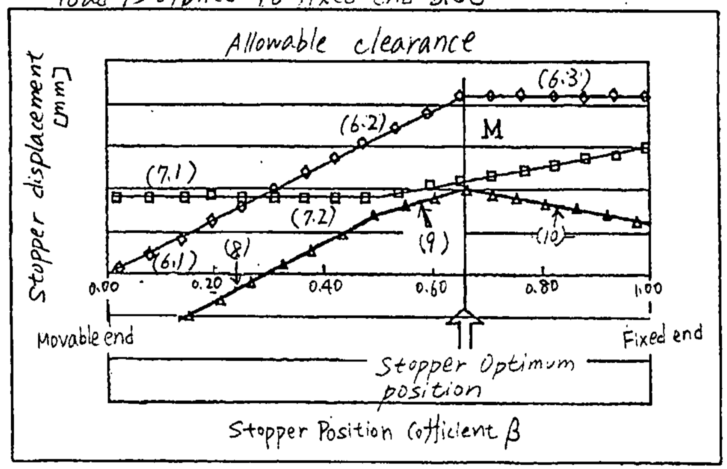
$$\delta l = \frac{2L^3 \cdot \beta \cdot Wl}{Ebt^3} \cdots (7.3)$$

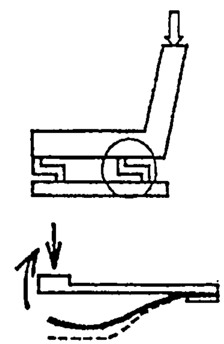
$$\delta u - \delta l = Yt = \frac{L^2}{3Et}\cdot \sigma e - \frac{2L^3 \cdot \beta \cdot Wl}{Ebt^3} \cdots (10)$$

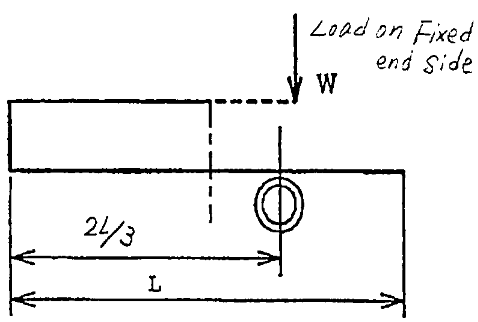
δe = Stress Limit

Wl = Lowest Load in Load Measurement range

Stopper Optimum Position for rear sensor installed in same directional forward orientation when offset load is applied to fixed end side







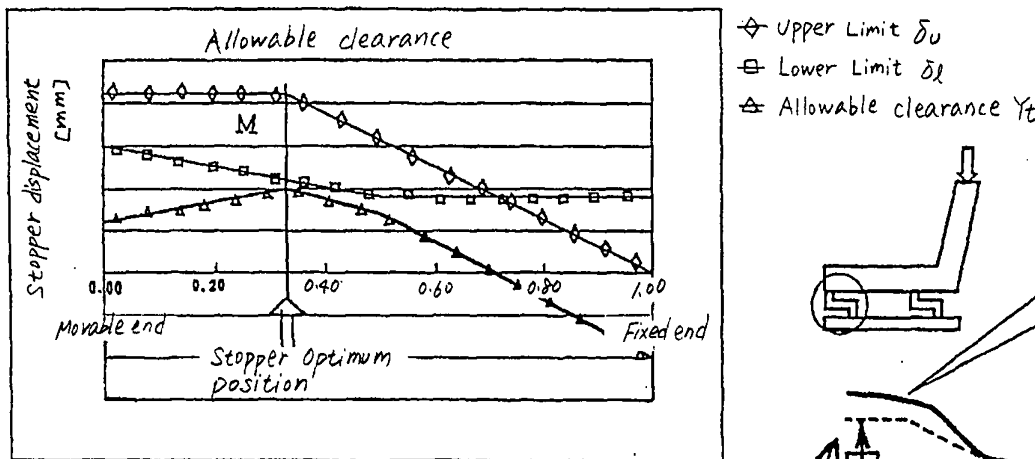
$$Yt=\frac{L^2}{2Et}\cdot\sigma e\cdot\beta-\frac{L^3\cdot Wl}{Ebt^3}\cdots\quad(8)$$

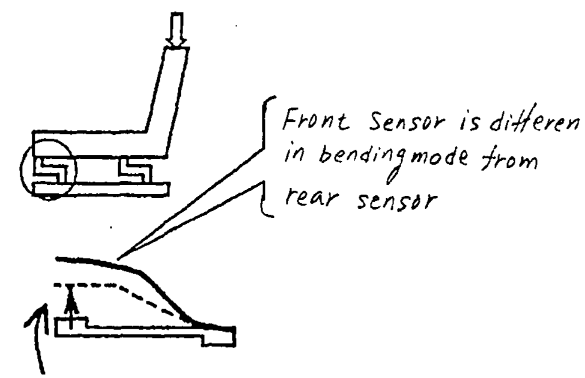
$$Yt=\frac{L^2}{2Et}\cdot\beta\cdot\sigma e-\frac{2L^3\cdot\beta\cdot Wl}{Ebt^3}\cdots\quad(9)$$

$$Yt=\frac{L^2}{3Et}\cdot\sigma e-\frac{2L^3\cdot\beta\cdot Wl}{Ebt^3}\cdots\quad(10)$$

Fig.14

Stopper Optimum Position for front Sensor installed in same directional frontward orientation when offset load is applied to movable end side





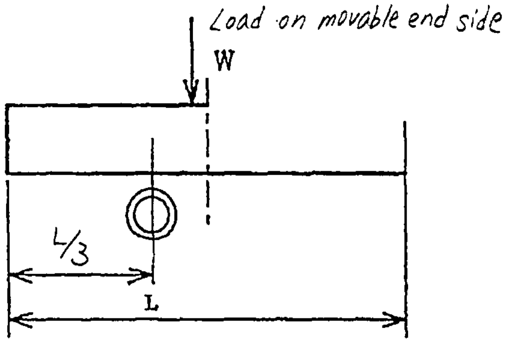


Fig. 15